
IEP QUARTERLY HIGHLIGHTS

USFWS Seasonal Fishery Catch and a Follow Up Investigation of Fish Fauna Assemblages in the Sacramento-San Joaquin River Delta and Bays.

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Background

Historically, the Stockton Fish and Wildlife Office, Delta Juvenile Fishes Monitoring Program has used beach seines, Kodiak (KDTR) and Mid-water (MWTR) trawls to investigate qualitative trends of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and other juvenile fishes in the Sacramento-San Joaquin River Delta and Estuary. This article reports the total fishery catch for the reporting period of 1 May 2005 through 31 August 2005. Additionally, this article follows up on the results of Wichman and Hanni (2005) by examining fish assemblage stability across regions over a four month period, May through August, during 1995 through 2005. Fish data were examined to identify differences in fish assemblage stability using catch per unit effort (CPUE) within beach seine regions and trawl locations over time. Beach seine and trawl location total species count data also were used to determine diversity trends for this time period over the previous 11 years.

Methods

The historical beach seine and trawl locations sampled are the same as in Wichman and Hanni (2005). The Sacramento-San Joaquin Delta and Bays are divided into 6 different regions: region 1 - Lower Sacramento River, region 2 - North Delta, region 3 - Central Delta, region 4 - South Delta, region 5 - San Joaquin River, and region 6 - San Francisco and San Pablo Bays. The trawling locations are located at Chipps Island, Sherwood Harbor, and

Mossdale. Mossdale sampling was conducted by the California Dept. of Fish and Game (DFG) from 1 April through 30 June, and we continued trawling July 1-August 31.

Fish sampling, data calculation and analysis follows Wichman and Hanni (2005) with these exceptions: the total number of years was increased from 6 years to 11 years (1995-2005) to investigate longer term assemblage stability, and Simpson's Index of Diversity (Krebs 1999) was calculated for each beach seine region and trawl location. The calculations for the variance of Simpson's Index of Diversity were computed from (Grundmann et al. 2001) as follows.

$$D = \sum p_i^2$$

where D = Simpson's Index

p_i = Proportion of species i in the community

The variance (σ^2) of D is defined as:

$$\sigma^2 = \frac{4}{n} \left[\sum (p_i)^3 - (p_i)^2 \right]$$

where n = # of individuals

The 95% confidence interval (CI) is defined as:

$$CI = \left[D - 2\sqrt{\sigma^2}, D + 2\sqrt{\sigma^2} \right]$$

Simpson's Indices of Diversity were plotted on a graph with trend lines and p-values calculated from a regression analysis (Figure 1).

Results

Chinook Salmon Summary (1 May - 31 August 2005)

For the reporting period, a total of 430 unmarked (assigned a race size class following Fisher, 1992) Chinook salmon (*Oncorhynchus tshawytscha*) were captured in beach seine samples. The majority of these salmon (92.5%) (Table 1) were fall run size captured in region 1, region 2 and region 3. Region 6 yielded one unmarked fall run size Chinook salmon during the reporting period. Regions 2, 3, 4, and 5 recovered a total of 54 marked salmon.

Our trawls captured 17,024 unmarked juvenile and adult Chinook salmon at the following locations: 15,595 Chinook were captured at Chipps Island; 1,067 at Sherwood Harbor MWTR and 2 in the San Joaquin River at Mossdale (Table 2). The majority of marked fish were recovered from Mossdale (Table 2; $n = 1,122$) in early May and are likely from fish releases conducted by DFG

and for the San Joaquin River Group Authority for the Vernalis Adaptive Management Plan.

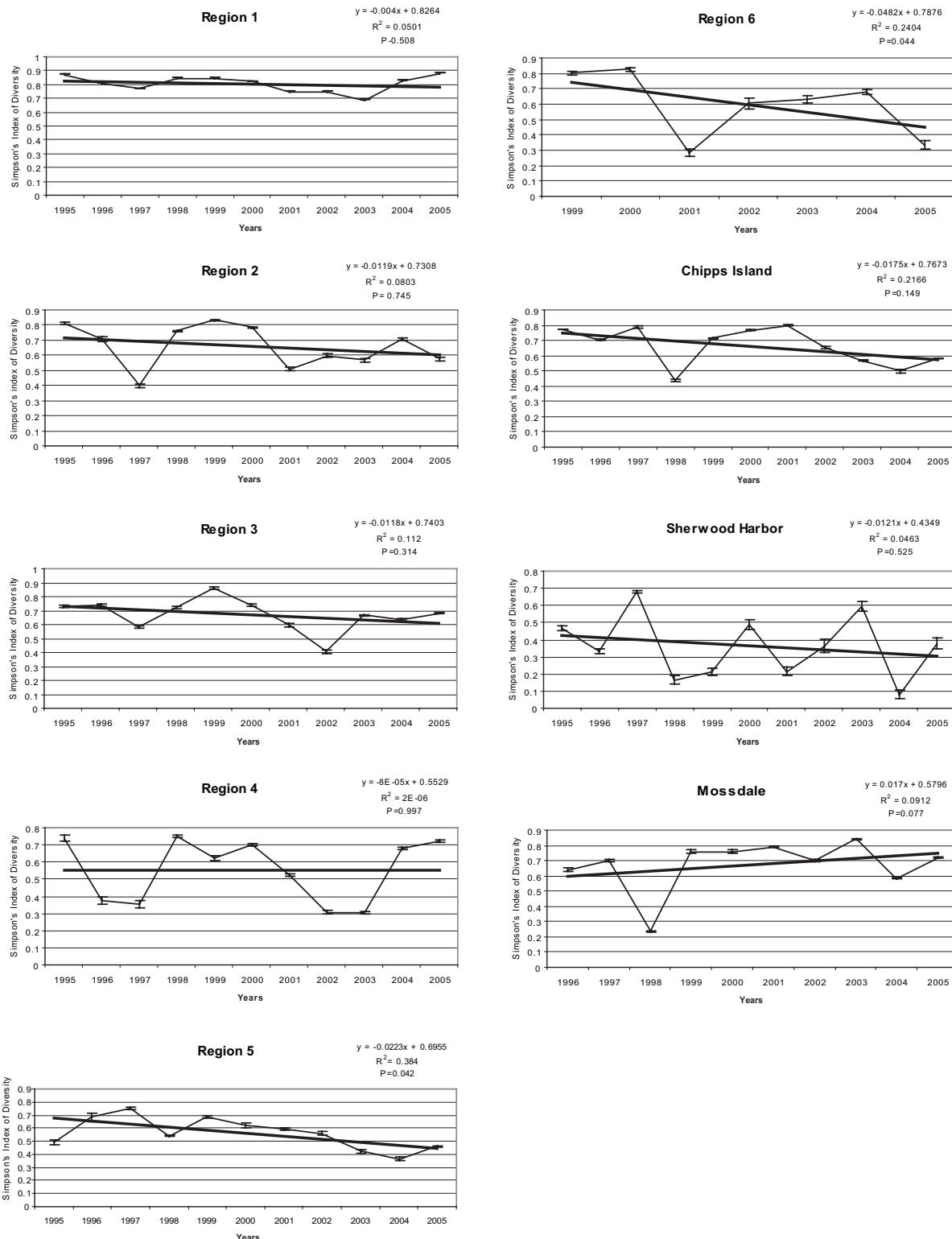


Figure 1 Graphs of Simpson's Index of Diversity over the previous 11 years for each beach seine and trawl location during the reporting period of 1 May through 31 August.

Table 1. Regional catch and CPUE of unmarked and marked Chinook salmon captured from beach seining during 1 May - 30 August 2005. Only unmarked fish were assigned a race size class.

Region # and Name	Volume (m ³)	Fall	CPUE	Late Fall	CPUE	Spring	CPUE	Winter	CPUE	Marked	CPUE
1. Lower Sacramento River	3,115.1	43	0.01380373	14	0.00449424	0	0	0	0	0	0
2. North Delta	6,901.6	221	0.03202179	12	0.00173874	0	0	0	0	35	0.00507132
3. Central Delta	6,337.8	83	0.01309613	2	0.00031557	0	0	0	0	0	0
4. South Delta	7,968.6	0	0	0	0	0	0	0	0	9	0.00112944
5. San Joaquin River	3,024.5	0	0	0	0	0	0	0	0	10	0.00330639
6. San Francisco and San Pablo Bays	4,938.8	1	0.00020248	0	0	0	0	0	0	0	0
Total		348		28		0		0		54	

Table 2. Catch and CPUE of unmarked and marked Chinook salmon captured at each trawling location during 1 May - 31 August 2005. Only unmarked fish were assigned a race size class.

Location	Volume (m ³)	Adult	CPUE	Fall	CPUE	Late Fall	CPUE	Spring	CPUE	Winter	CPUE	Marked	CPUE
Chippis Island mid-water trawl	27,642,018	10	3.618E-07	15,669	0.0005669	7	2.53E-07	275	9.94862E-06	1	3.61768E-08	858	3.10397E-05
Mossdale Kodiak trawl	12,303,439	0	0	1	2.177E-05	0	0	1	8.12781E-08	0	0	1,122	9.1194E-05
Sherwood Harbor mid-water trawl	8,574,983	0	0	1,053	0.0001228	1	1.1662E-07	13	1.51604E-06	0	0	32	3.73179E-06
Totals		10		16,723		8		289		1		2,012	

Fish Assemblage

Beach Seine Samples

For the reporting period of 1 May through 31 August 2005, 51 fish species were captured for a total of 56,793 fish in 612 total beach seine samples (est. vol. = 32,286 m³). A total of 5,193 fish and 31 species were captured from region 1 (Table 3). In region 2, a total of 8,298 fish comprising 37 species were captured. In region 3, a total of 15,076 fish and 28 species were captured. In region 4, a total of 8,304 fish from 25 species were captured. In region 5, a total of 18,241 fish and 19 species were captured. Fifteen species comprised of 1,681 individuals were captured in region 6.

The most abundant fish captured overall were non-indigenous: inland silversides (*Menidia beryllina*; n=15,435) and red shiners (*Cyprinella lutrensis*; n=15,088). Alternatively, the highest catch of native fish were Sacramento suckers (*Catostomus occidentalis*) (n=4,289) and Sacramento splittail (*Pogonichthys macrolepidotus*; n=1,252). Between May and August 2005, one to six species comprised a minimum of 75% of the fauna captured within a region (Table 3). Priority species

captured were winter run Chinook salmon (n=0) and Delta smelt (*Hypomesus transpacificus*; n=10). The total catch from the ten previous years is not summarized here but is available from our office or on BDAT at <http://www.iep.ca/data.html>.

Fish assemblage stability (W_c), measured as consistency in ranks of species CPUE between May and August from 1995-2005, was calculated for each region. (Wichman and Hanni 2005) Region 1 had the greatest stability within the fish assemblage (W_c = 0.79). Regions 2, 3, 4, and 6 all demonstrated moderate stability, W_c = 0.74, 0.68, 0.72, and 0.69, respectively. Region 5 had the lowest W_c value at W_c = 0.59.

Fish diversity between May and August of 1995 through 2005 exhibited a declining trend for all beach seine locations, except region 4 (Figure 1). However, only region 5 and region 6 had a statistically significant decline in near shore fish diversity as detected by beach seines (p < 0.05).

Table 3. Species that comprise greater than 75% of the fishes captured within each beach seine region and trawl sample area during 1 May - 30 August 2005.

	Species	(n)	% of total fish captured	Total Fish Captured	Total Species
Beach Seine Region					
1. Lower Sacramento River (n = 7 sites)	TOTAL	2,566	75%	5,193	31
	Sacramento Sucker	1,282	25%		
	Golden Shiner	672	13%		
	Sacramento Pikeminnow	612	12%		
	Mosquitofish	486	9%		
	Inland Silverside	467	9%		
	Threadfin Shad	390	8%		
2. North Delta (n = 10 sites)	TOTAL	5,898	78%	8,298	37
	Inland Silverside	5,313	64%		
	Sacramento Splittail	585	7%		
	Sacramento Sucker	581	7%		
3. Central Delta (n = 9 sites)	TOTAL	11,609	77%	15,076	28
	Splittail	6,009	40%		
	Inland Silverside	5,600	37%		
4. South Delta (n = 8 sites)	TOTAL	5,683	89%	8,304	25
	Inland Silverside	2,880	35%		
	Theadfin Shad	2,803	34%		
	Red Shiner	1,695	20%		
5. San Joaquin River (n = 10 sites)	TOTAL	13,171	81%	18,241	19
	Red Shiner	13,171	72%		
	Sacramento Splittail	1,593	9%		
6. San Francisco and San Pablo Bays (n = 9 sites)	TOTAL	1,365	81%	1,681	15
	Topsmelt	1,365	81%		
Trawl Location					
Chippis Island	TOTAL	26,696	90%	29,731	31
	Chinook Salmon (fall)	15,669	53%		
	American Shad	11,027	37%		
Mossdale	TOTAL	15,775	78%	20,388	25
	Splittail	9,257	46%		
	Threadfin Shad	4,944	24%		
	Red Shiner	1,574	8%		
Sherwood Harbor (mid-water)	TOTAL	1,053	78%	1,356	20
	Chinook Salmon (fall)	1,053	78%		

Trawl Samples

We conducted 2,511 trawls (est. vol.= 48,520,440 m³) between May and August 2005 and captured 39 different species for a total of 51,475 fish. Chipps Island trawls yielded 31 different species for a total of 29,731 fish (Table 3). At Mossdale, 25 different species were captured for a total of 20,388 fish. Sherwood Harbor trawls captured 20 different species for a total of 1,356 fish. Four species comprised at least 75% of the total fauna captured at all trawling sites (Table 3). The most abundant species captured overall were native fall run size Chinook salmon ($n = 16,723$) and non-native American shad ($n = 11,275$), of which 94% and 98 %, respectively, were captured at Chipps Island. Species of concern captured in trawling included Sacramento splittail ($n = 9,257$), Delta smelt ($n = 43$), winter run size Chinook salmon ($n = 1$), and unmarked steelhead ($n = 29$).

W_c was calculated to assess fish assemblage stability over time for each trawling site. All trawling locations had moderate stability between 1995 and 2005: Chipps Island $W_c = 0.71$; Mossdale $W_c = 0.68$; and Sherwood Harbor MWTR $W_c = 0.63$.

Using Simpson's Index of Diversity, diversity trends were graphed for each trawl location (Figure 1). Chipps Island ($p < 0.149$) and Sherwood Harbor MWTR ($p < 0.525$) trawl locations appear to have a declining trend in fish species diversity, while Mossdale has a slight increasing trend ($p < 0.077$).

Discussion

Total catch was greater (22,111 individuals) between May through August 2005 sampling period than that reported for Jan through April 2005. If the most dominant species are removed from the total catch, assemblage stability would greatly decrease. Assemblage stability and diversity measurements are sensitive to dominant species numbers, further investigation of native versus non-native and abundant versus common species may give better estimations on true stability and diversity.

As discussed in the previous newsletter (Wichman and Hanni, 2005), CPUE rank consistency over time (Kendall's W_c) is a broad ecological approach and one way to preliminarily examine inter-annual fish assemblage stability. The relatively high Kendall's W_c values show that if a species CPUE for 2005 had a high rank

(more abundant) then it is very likely that the same species had high relative abundance in each of the previous five years. The same is true for mid and low ranked species (ie., ranks for species within an assemblage are not changing greatly during the study period). From the months of May through August during 1995 and 2005, there is moderate stability within the fish assemblage for each region or location. Assemblage stability was lower from May through August 1995 - 2005 than Jan to April 1999 - 2005; however, this could be misleading since the same number of years weren't compared and may increase or decrease variation in stability. Although most regions and trawl locations show a declining trend in species diversity, variation was too great to make any definitive inferences. Since diversity was not statistically significant and was variable from year to year, examination of a larger data set (15-20 years) may be useful at describing longer term diversity trends.

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Literature Cited

- Brandes, P. et al. 2001. Delta juvenile salmon monitoring program review. Delta Salmon Project Work Team. Stockton (CA) USFWS.
- Fisher, F.W. 1992. Chinook salmon, *Oncorhynchus tshawytscha*, growth and occurrence in the Sacramento-San Joaquin river system. Draft Inland Fisheries Division Office Report. Sacramento (CA): California Department of Fish and Game.
- Grundmann, H. et al. 2001. Determining Confidence Intervals When Measuring Genetic Diversity and the Discriminatory Abilities of Typing Methods for Microorganisms. Journal of Clinical Microbiology, November 2001, p. 4190-4192, Vol. 39, No.11.
- United States Fish and Wildlife Service. 2005. Stockton Office Standard Operating Procedures.

Wichman, L. and J. Hanni. Chinook Salmon Catch and A Preliminary Look at Fish Assemblages in the Sacramento-San Joaquin River Delta and Bays. IEP Newsletter Summer 2005.

Zar, J.H. 1999. Biostatistical Analysis, Fourth Edition. Prentice Hall, Upper Saddle River, New Jersey.

Delta Smelt Culture Facility Project Update

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The Fish Conservation and Culture Laboratory (FCCL) formerly established as the Delta Smelt Culture Facility has made substantial changes during the past two

years. Production has increased and a significant expansion has been completed. New tanks have been added with funding provided by the Department of Water Resources (DWR). The expansion was done to increase our production capabilities and provide delta smelt (Table 1) to the Department of Fish and Game for the Collection, Handling, Transportation and Release studies (CHTR).

The new FCCL has a water treatment plant, which supplies up to 80 gpm. The old system provided a clean water source for only 10 gpm. Our facility is now designed to rear each life stage in separate labs, each with their own recirculation systems and the appropriate tank size for each life stage.

Production of delta smelt has continued to increase with each season. Improvements over the last two years are largely attributed to improved spawning techniques and a new incubator design. We are currently holding over 10,000 adults, primarily for the CHTR studies.

Table 1 Total number of each life stage of delta smelt provided to different agencies and principal investigators(PI) during 2005

Project	Agency - PI	Larvae (<20 mm)	Juveniles (20-49 mm)	Adults (>50 mm)	Total
Tagging Study (Photonic biobeads)	USBR – Sutphin	0	0	800	800
TFTF (Facility evaluation and screen design)	USBR	53,167	0	2,547	55,714
Marking Study (Calcein and Alizarin Red)	CDFG – Morinaka	0	71	0	71
CHTR (Acute Mortality, Stress tests, Predation)	CDFG – Morinaka, Afentoulis, Aasen	0	2,168	890	3,058
Toxicity test	UCD – Werner	0	619	0	619
Total		53,167	2,858	4,237	
Total for all projects					60,262